

temperature rose above 100° and 14 years when the minimum temperature fell below 0°F.

The average temperature for the seasons is as follows: Winter, 31.6°; spring, 49.7°; summer, 72.3°; and fall, 52.5°.

January is the coldest month, with a mean temperature of 29.4°; but the lowest average monthly temperature is credited to February, 1903, which was 20°. The warmest month is July, whose mean is 75.4°.

There are 89 rainy days in Salt Lake City, and the average annual precipitation is 16.24 inches. The wettest year was 1875, when 23.04 inches were measured; the driest in 1890, 10.33 inches. April is normally the wettest month and July the driest. No excessive rainfall ever occurs in Salt Lake City. The greatest 24-hour amount was 2.72 inches, in May, 1901. The heaviest rain in one hour was 0.91 inch, on July 19, 1912. The average snowfall is 50.6 inches, most of which falls from December to March, inclusive.

In general, the climate is agreeable when one considers the effect of a year's experience. The warm summer days are accompanied by low humidities, followed by cool nights. The winter temperatures are sometimes quite low, but never for long periods.

#### CLIMATIC CONTROL OF CROPPING SYSTEMS AND FARM OPERATIONS

By J. F. VOORHEES.

[Author's abstract.]

The object of this paper is to prove that all successful cropping systems must be based on climatic conditions.

By cropping systems we refer to the number of crops that are grown successively on the same ground in one year, as a one-crop system or a two-crop system.

Climatic control may be positive or negative. Negative control is exercised when climate prevents us from growing more than a certain number of crops and when it permits us to grow a certain number of crops. Positive control is exercised when climate penalizes us for failure to grow as many crops as possible.

The climatic factors considered are rainfall, length of growing season, and heat intensity. Variations of these factors give us a great variety of climates, as the continuous-crop climate, the two-crop climate, the one-crop climate, and the no-crop climate.

Negative or preventive control is exercised in all but the continuous-crop climate, while positive control is exercised mainly in those regions where more than one crop can be grown.

Temperature controls our crop successions and our farm operations through control of the length of time required for the growth and maturity of both plant and insect life.

The penalty for failure to use a proper cropping system is loss of the farm. This is proved by the fact that many worn-out farms have been reclaimed by proper cropping systems.

To comply with the demands of climate more knowledge of the relationship between plants and animals on one side and climatic conditions on the other is needed. This knowledge can best be obtained through cooperation.

#### THE THUNDERSTORMS OF THE UNITED STATES AS CLIMATIC PHENOMENA.

By Prof. ROBERT DeC. WARD.

[Author's abstract.]

As essential characteristics of American climate, thunderstorms have a broad human interest. From the viewpoint of climatology, the distribution of thunderstorms is of more interest than their mechanism. The part played by their rains in watering our crops is of greater importance than the size of the raindrops. The damage done by their lightning and hail concerns us more than the cause of the lightning flash or than the origin of the hailstones. The thunderstorms of the eastern United States are among the most characteristic of American climatic phenomena. In size, intensity, and frequency of occurrence they are unique.

No part of the country is entirely free from thunderstorms, but the two regions of greatest activity are in Florida and in northern New Mexico. It is over the immense area east of the Rocky Mountains that our great State-wide thunderstorms occur, which often last for many hours, and may cover a territory stretching from the Mississippi Valley to the Atlantic coast. Throughout this area also, on hot summer afternoons, hundreds of scattering sporadic thunderstorms often occur, of local importance because supplying rain. These local storms are more frequent in southern than in northern sections, and as a whole the northern tier of States has distinctly fewer thunderstorms than the southern.

The thunderstorms of the mountains and plateaus of the West are chiefly sporadic and short-lived. They supply the rainfall of the higher elevations, commonly known as "islands" of rainfall, though obviously more appropriately termed "lakes." On the Pacific slope thunderstorms are not often experienced on the immediate coast, but occur

more frequently in the interior valleys and on the mountains. They are characteristic summer phenomena at the greater elevations and furnish much or all of the "dry season" rainfall of those localities.

In relation to man's activities, it is of significance that most thunderstorms occur at the time of year and at hours when outdoor activities are at their height. The Southern States may be said to be in the thunderstorm belt all the year. As spring and summer come on, this belt moves northward. Taking the country as a whole, July brings most thunderstorms. Late spring and early summer bring considerable thunderstorm rainfall of marked economic importance over the eastern Rocky Mountain foothills and the Great Plains, while over the plateau region thunderstorms are most frequent in late summer. On the Pacific slope the inland thunderstorms show a preference for summer; the rarer ones of the immediate coast develop chiefly in winter.

A broadly generalized composite weather map is given, showing conditions under which "cyclonic" thunderstorms are likely to occur over the area from the Mississippi Valley eastward, and another map, also generalized, shows conditions favorable for the development of "heat" thunderstorms over the eastern United States.

Thunderstorms bring us much that is of benefit. To them we owe much, in parts of our country even most, of our spring and summer rainfall. Without these beneficent thunderstorms our great staple crops east of the Rocky Mountains would never reach maturity. One good thunderstorm over a considerable area at a critical crop stage is worth hundreds of thousands of dollars to American farmers. Our stock markets time and again show the favorable reaction of such conditions upon the prices of cereals and also of railroad and other stocks. Thunder-showers break our summer droughts, cleanse our dusty air, refresh our parched earth, replenish our failing streams and brooks, bring us cool evenings and nights after sultry and oppressive days.

#### THE ECONOMIC ASPECT OF CLIMATOLOGY.

By EDWARD LANSING WELLS.

[Author's abstract.]

The economic status of the individual depends to a degree upon his environment and upon his ability to select a favorable environment or to make the most of that which is inevitable in his environment. Natural resources constitute a part of one's environment, and climate is an important natural resource.

Climate is intimately related to agriculture, engineering, transportation, commerce, manufacturing, health and efficiency, recreation, safety, and to practically every human activity.

It controls the distribution of vegetation, both as to kind and quantity, and successful agriculture depends upon a knowledge of climatology and how to make the best of existing conditions. Its relation to agriculture is indirect as well as direct, having to do with problems of irrigation, drainage, transportation, manufacturing, marketing, and the efficiency of labor, as well as with the control of insect pests and fungous diseases.

In engineering work climatology is of value in the development of water power and wind power, in the construction and maintenance of transmission lines, whether for power or for communication, in construction and operation of irrigation systems, in the construction of buildings, bridges, railroads, water-supply systems, sewers, and heating and refrigeration plants.

Few commodities are used where they are produced, and climatology enters largely into most of the problems of transportation. Sailing routes are laid out so as to take advantage of the great wind systems and to avoid storm tracks and fog areas. Floods, deep snows, high winds, etc., are to be considered in laying out railroads, and perishable freight must be protected in accordance with existing and expected weather conditions. Claims for damage to perishable freight and for car demurrage are often settled on the basis of weather records. Climate should be carefully considered in building and maintaining automobile roads.

The price of commodities, property, and labor depends to a certain extent upon supply and demand, and both supply and demand are affected by the climate. The prices of foodstuffs may vary rapidly under the influence of weather changes. Insurance rates are based, in part, upon the showing made by the weather records, and life insurance companies sometimes refuse policies to residents of States known to have an unhealthy climate. The distribution of many commodities, such as clothing and farming implements, is governed by the demands of the climate. Advertising, routing of salesmen, the location of distributing depots, and the pressing of collections depend upon weather conditions. The means of commercial communication are often good or bad, as the climate is favorable or unfavorable. In the storage of perishable products, studies of the climate are absolutely necessary. Conventions and fairs, having a commercial value to the localities where held, are attracted to places where the climate is known to be favorable.

Many manufacturing industries are regional because they demand certain climatological conditions. Among these may be mentioned the manufacture of tobacco products and textiles. The character of the